Amendments to the Specification

Amend the specification as follows:

The paragraph at page 21, line 16 as follows:

The test box making up single test port housing 21 has first and second metal flanges 24, 25 in each of which is disposed a continuous first and second ~~o-ring~~ O-ring seal 26, 27 (best shown in Figure 5). As will be clear from the discussion below, the seal integrity for first O-ring seal 26 (forming test gas chamber 32) is not as critical for the seal integrity of second O-ring seal 27 forming measurement chamber 33. Technically, if test gas chamber 32 was at atmospheric or slightly positive pressure, the continuous flow of the test gas would prevent atmospheric air entering test gas chamber 32 and a seal would, strictly speaking, not be required. Similarly, if the test gas chamber 32 was at a slight underpressure, the demands on first seal 26 would be slight, i.e., the seal must be sufficient to draw the slight underpressure. Leakage or seal integrity is not that critical for test gas chamber 32 because of continuous flow of the test gas which will purge any ambient gas entering test gas chamber 32 vis-a-vis the seal. In the preferred embodiment, both first and second seals 26, 27 are identical. It is simply noted that because the demands on the seals are different, other types of seals can be used for test gas chamber 32. However, O-ring seals are preferred in any event because no damage to the sample results from their use.

The paragraph at page 22, starting at line 4, as follows:

Sealed between first and second ~~o-ring~~O-ring seals 26, 27 is sample barrier material coupon 30. In the prototype device barrier material coupon 30 had a dimension of approximately 4 inches by 4 inches and first and second ~~o-ring~~O-ring seals 26, 27 are identical to one another and circumscribe a specimen sealed area 20 of approximately $50cm^2$. With barrier material coupon 30 sealed in place between first and second ~~o-ring~~O-ring seals 26, 27 the test box forms a test gas chamber 32 (shown as the top

chamber in Figure 2) and a measurement chamber 33 (shown as the bottom chamber in Figure 2). The only communication between test gas chamber 32 and measurement chamber 33 is barrier material coupon 30, which, by definition, is permeable. For definition, test gas chamber 32 and measurement chamber 33 together form a port 34, which is opened along a parting line defined by metal flanges 24, 25. For the multi-port prototype embodiment, ports 34 and their associated components will be designated by reference letters A, B, C and D following the reference numerals.

The paragraph at page 22, starting at line 27, as follows:

A high vacuum valve 44 provides fluid communication between measurement chamber 33 and a header 45 connected to a high vacuum manifold 46. In fluid communication with high vacuum manifold 46 is ~~an or~~a mass spectrometer 48. In the prototype (Figures 2-6) the mass spectrometer is an MKS/SPECTRA mass spectrometer which is supplied complete with a pc (personal computer) and a monitor (model MicroVision Plus). The MKS spectrometer has a minimum partial pressure sensitivity of less than 2×10^{-11} Torr, and a minimum detectable concentration of less than 80 ppb for all gases except hydrogen (10 ppm). Measurable range of the MKS mass spectrometer is 1-100 amu (atomic mass units). Also in fluid communication with high vacuum manifold 46, is a high vacuum pump 50. In the prototype system, high vacuum pump 50, is a 550 l/s (liters per second) Varian Turbomolecular pump and is backed by a second roughing pump 51 to make the system suitable for O_2 service i.e. exhaust to atmosphere. In the prototype system both roughing pumps 35, 51 are Varian dry mechanical scroll pumps. In accordance with the broader definition of the high vacuum pump, a diffusion pump could be substituted for the Turbomolecular pump but the diffusion pump would also be backed by a roughing pump.

The paragraph at page 23, starting at line 28, as follows:

The operation of the instrument will be described in detail below. A general overview of operation is to isolate high vacuum pump 50 from measurement chamber 33 and actuate first roughing vacuum pump 35 to pull an equal vacuum in both test gas

chamber 32 and measurement chamber 33. High vacuum valve 44 is then opened allowing high vacuum pump 50 to pull a high vacuum in measurement chamber ~~36~~33 while test gas chamber 32 is at the initial roughing vacuum level. Test gas line 40 is then valved into communication with test gas chamber 32 with rate of flow established by mass flow controller 42 which in turn is set by capacitance manometer 38 to produce a desired pressure differential between test gas chamber 32 and measurement chamber 33. Mass spectrometer 48 then operates in a conventional manner scanning through its measurable range (1-100 amu) to continuously detect in each scan the particular gas of interest. Flow of the gas of interest into and out of test gas chamber 32 is continuous and test gas chamber ~~42~~32 is maintained at a constant vacuum, although in theory, test gas chamber 32 could reach atmospheric pressure.

The paragraph at page 24, starting at line 14, as follows:

The prototype unit constructed included a multi-port sample holder 22 as shown in Figures 3, 4, and 5. Figure 3 shows multi-port sample holder 22 mounted to the vacuum test instrument frame 60 with only portions of the test instrument shown. In the prototype, multi-port sample holder 22 has four ports, 34A-34D, each of which comprises a test gas chamber 32 and a measurement chamber 33 generally in a circular or elliptical configuration (as defined by first and second ~~o-ring~~O-ring seals 26,27). In fluid communication with each test gas chamber 32 is a test gas fitting 62 there being four such fittings designated by reference numeral 62A, 62B, 62C, and 62D. As shown in Figure 3, each gas fitting 62 connects to a gas manifold 63 which in turn will be connected to a pressurized gas container resting on a ledge 65 in test instrument frame 60, and connected by appropriate valves and mass flow controllers into gas manifold 63 (not shown). Also connected to each test gas chamber 32 is a rough vacuum fitting 66 (66A, 66B, 66C and 66D shown) and a rough vacuum fitting (not shown) is also provided for each measurement chamber 33. All rough vacuum fittings are in fluid communication through appropriate valves to a roughing exhaust manifold 67, a portion of which is shown in Figure 3. Also shown in Figure 3 are high vacuum valves designated 44A, 44B, 44C and 44D, high vacuum pump 50 and a mount 68 for mass spectrometer 48.

The paragraph at page 33, starting at line 18, as follows:

In this regard, reference can be had to Figure ~~98~~ 8 which shows a constructed trace 120 of a gas transmission curve plotted as cc of transmitted gas over time. As discussed above, trace ~~199~~119 has an initial condition, at time T_O followed by a rising condition designated by reference numeral 120 until a generally flat equilibrium condition occurs at time T_F. If the difference in gas transmission between the initial condition T_O and the equilibrium condition at T_F is large enough to approach a magnitude of 10^{-3} cc/m^2/day, then conventional instruments can detect the permeance of the gas of interest. If the equilibrium condition is a lower order of magnitude, i.e., 10^{-4} or lower, detection is not possible. Thus, the inventive instrument, because it has sensitivities at the lower orders of magnitude, can function in a "normal" test environment to determine the gas transmission rate at equilibrium and thus determine permeability of the barrier material. However, this invention is able to discern the gas transmission values during rise portion 120 of the gas transmission curve. For example, the instrument can detect early gas transmission points 120A, 120B, 120C at times T_1, T_2 and T_3, respectively. Early gas transmission points allow the rise portion 120 of the gas transmission curve 119 to be constructed using any one of a number of known curve fitting techniques (i.e., a linear slope can be readily calculated) and the constructed rise portion compared to a stored rise portion (from a prior sample tested to equilibrium) to quickly determine a pass/fail condition. Different samples will exhibit different curves, e.g. 121, similar to 119 but with different slopes. A superior barrier sample will exhibit a gas transmission curve, which rises more slowly, while an inferior barrier will yield a more rapid rise in gas transmission. Alternatively, several readings of gas concentration over time can be compared to a band shown as dotted lines 122 based on statistical analysis of prior samples tested to equilibrium. Readings within the band indicate a "pass". For example, gas concentration readings 121A, 121B, 121C taken at different times, T_1, T_2 and T_3, are compared with values from statistical analysis of prior samples taken at times T_1, T_2 and T_3. Gas concentration 121C is the maximum allowed concentration value (y-axis value) for a pass. . Any sample with all gas concentration values below the top horizontal line 122,

i.e., within the pass band, at all three test times, T_1, T_2 and T_3 is a pass sample. In practice, a concentration level above zero is commonly measured at the start of the time periods, T_O. This value at T_O determines the bottom of the pass band (second dashed line in Figure 8).

The paragraph at page 34, starting at line 27, as follows:

Helium is lighter than other gases of interest which are typically selected (oxygen, water vapor etc) to determine the effectiveness of a barrier material. The molecular activity of helium can be significantly increased by the use of heaters 82 thus increasing its transmissability characteristics through the barrier material. This aspect of the invention recognizes that equilibrium conditions for the helium can be quickly established because the gas readily passes through smaller transmission paths or pinholes which take a longer time for the heavier gases to pass through. Recognizing that the transmission characteristics of any gas of interest through a barrier material is a function of the atomic mass weight of the gas and that transmission paths, i.e., micro-cracks and/or pinholes - "defects", "open" over time. A correlation of helium to any gas of interest is possible per this separate aspect of the invention. Testing to equilibrium conditions ("Y") occurs over a shorter time span because the barrier material can achieve saturation more quickly with a lighter gas, particularly helium (see Figure 9). Further, if the helium is excited by heating then equilibrium conditions will be more quickly reached. Thus test time at saturation or equilibrium, for any permeation measuring system is reduced if helium is selected as the gas of interest. The correlation step can take a number of various forms known to those skilled in the art. For example, a gas transmission curve for a given gas of interest from an unsaturated to a saturated condition can be generated. Similarly, the same trace for the same barrier material can be developed with helium and the traces superposed on one another to draw difference correlations. For example, time to reach saturation for a given gas of interest from T_o to T_{FGO} is established as "X", and this correlates, for that barrier material, to a time to reach saturation with helium from T_O to T_{FH} of "X-Y". See, for example, Figure ~~10~~9.